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FARMER'S ADOPTION OF IMPROVED TECHNIQUES OF SWEET POTATO PRODUCTION IN NIGER STATE, NIGERIA

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O.J. Ajayi.*

Abstract

The study was conducted in Niger state Nigeria; it investigated the factors affecting the adoption of improved sweet potatoes technologies. Two local Governments were purposively selected and a total of one hundred and fifty (150) sweet potato farmers were randomly selected from 2 extension blocks from the two local Governments. A well-structured interview schedule was used to elicit information from the respondents. The data collected were analysed using descriptive statistical tools such as frequency tables, percentage, mean, and regression statistical tool (logit model) was also used to determine the factors affecting adoption. The result revealed that Age (X_1), Farm size (X_2), Educational level (X_3), Farming experience (X_4) and household size (X_5) had a significant relationship with adoption. Furthermore, the level of awareness of improved potato techniques among the respondents was high (98.0%), however 2.0% claimed they were not aware. The study also shows that extension agents (40%) and friends and neighbors' (42.7%) were the principal sources of information and distribution of improved potato technology packages. The following technologies were highly adopted, fertilizer use (3.6), weeding regime (3.7) and harvesting techniques (3.9). Some constraints to technology adoption includes small farm size (63.3%), high cost of technology (56.7%), inadequate extension contact (60.0%) complexity of technology (68.7%) and also inadequate credit (74.7%). All the constraints were however perceived as important (with mean scores equal to or above 3.0) in exception of religious belief (1.8.) The significant mean difference in yield before and after adoption of improved potato technologies reveals that adoption of improved technologies has significant effect on the output of the potato farmers and consequently on their income and standard of living.

Key words: Adoption, Improved techniques, potato,

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Sweet potato (*ipomoea batatas*) is one of the world widely grown and valuable crops. It is highly adaptable to relatively marginal soils and erratic rainfall, has high productivity per-unit land and labour, and guarantees some yield even under the most adverse conditions (Nwokocha 1993 and Ogbonna *et al,* 2005). Farmers in more than 100 countries in the tropics, subtropical and warm temperate areas rely on it for its ability to produce high yields on marginal land with little investment (Horton *et al*, 1998). It has high energy fixing efficiency, produces much dry matter at a short period of time and contains high levels of vitamin A (Nwokocha 1993, 2002). It serves as feeds for animals and raw materials for industries. It is grown over a wide range of environment with latitude 30^0N and 30^0S and altitudes as high as 2000m above sea level. Sweet potato can yield over a long period of time; one crop may be harvested for as long as six years.

Adoption is regarded as decision to make full use of an innovation or technologies as the best of action available. According to van den Ban and Hawkins (2006) an innovation is an idea, object or method which is regarded as new by an individual, but which may not always be the result of recent research. Adoption of an innovation is a decision of an individual or group to use or apply as innovation. Most farmers are said to passed through a logical, problem solving process when considering any new technology or innovation (Swanson et al, 1996).

Agbamu (2006) reported that farmers' characteristics such as knowledge, market orientation and innovativeness influence the adoption gap significantly. In addition farmers' knowledge of innovation is an important factor in the adoption process. Lack of technical know-how on the use of technology by farmers can be a serious constraint to the adoption and the success of that innovation. Agbamu (2006) ;Obibuakau and Hursh (1994) and Obeta & Nwagbo (1991), noted that the adoption of technology is a function of the characteristics of the technology proposed, farmers perception of its advantages and need, as well as availability and distribution of

production factors. Other factors that affect the adoption of any technology are; Farmers attitude towards experiment and risk, institutional support/knowledge sharing and the policy environment surrounding the technology. Infrastructure such as roads and irrigation plays key roles in facilitating technology adoption. Improved transportation is also association with diffusion of technology, better use of inputs and better prices for farmers (ATAI 2011 and Agbamu 1998).

According to Nwamkhewu and Agbamu (2006) One of the way farmers use in gathering or gaining information is on the basis of interpersonal and personal sources of information. The interpersonal sources of information dissemination are those communication contacts involving direct face-to-face exchange of word between communicator (Encoder) and receiver (Decoder). The second means of disseminating information can be categorized as follows:

Commercial source which includes Dealers and Salesman.

Informal source which includes relatives, friends and neighbour.

Government/ Agricultural agencies which also includes institutions of Agricultural Extension Agencies.

Mass Media, which includes television, radio, posters, farm/agricultural magazine and bulletins etc.

Nweke et al. (2004) concluded that, personal contact tends to be more important than formal mass media both in term of total exposure and effective exposure.

Inadequate skills on the method of production of sweet potato have been one of the major constraints to improving sweet potato production, farmer's income and livelihood, and globalization of agriculture in Nigeria. Despite the excellent qualities and potentials of sweet potato in achieving household food security, the level of production and consumption of sweet of

potato in chanchaga and shiroro L.G.A of Niger state remains on an average level. This is as a result of a poorly developed agricultural system compounded by unfavourable macro and micro-economic policy frame work, unhealthy seed varieties, uncertified seeds, seeds being subject of seed-borne diseases, poor storage facilities amongst others. International potato centre (IPC) (2012) declared that for poor potato farmers in developing countries yield is essential to their ability to achieve economic independence and food security. While average potato yield in North America Western Europe often reach 40 metric tons per hectare , yield in developing countries are usually below 20 metric tons per hectare, this of is a persistent and sizable yield gap. Most of this yield gap can however, be closed through adoption of improved potato production technologies and helping farmers realise this crop economic potentials.

On the bases of the above, this study was designed to achieve the following objectives: identify the sources of information about the improved techniques of sweet potato production, determine the level of adoption of the improved techniques of sweet potato, determine the factors affecting the adoption of improved sweet potato techniques and to examine the constraints associated with the adoption of improved sweet potato production technologies and farmers' perception of the constraints.

HYPOTHESIS

There is no significant difference in potato yield before and after adoption of improved potato production techniques

The objectives were achieved through descriptive statistics such as frequency, percentages, mean, 4 point Likart type of scale and through inferential statistics, mainly through Logit regression model to determine the factors affecting adoption of improved sweet potato production techniques.

Model specification

The Logit model was used to determine the variables that influence the adoption of improved potato production techniques amongst farmers which is specified in linear form.

$$Y=F(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9)$$

Where;

Y= level of adoption

X_1= Age of the farmer (in years)

X_2= farm size (ha)

X_3= level of education (years spent in formal edu.)

X_4= farming experience (in years)

X_5= household size

X_6= access to extension

The Explicit function is specified as,

$$Y=b_0+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+U$$

Where, Y, X_1-X_9 are defined as above

b_0-b_9 are the coefficients of the parameters estimated

U is the error term

Table 1: Distribution of respondent based on awareness and sources of information about improved technologies of sweet potato production.

Variables	Frequency	Percentage (%)	Awareness
Aware	147	98.0	
Not aware	3	2.0	

Sources of information

Friends & neighbours	64	47.2
Extension agents	60	40
Print/mass media	26	17.3

Source: Field survey,2012

Table 1 reveals that majority (98%) of the respondents were aware of the existence of improved sweet potato varieties. This implies that the propensity of the potato's farmers to accept and eventually adopt improved sweet potato varieties is likely to be very high, since many previous studies had shown that awareness is significantly and positively related to adoption. The table also shows sweet potato farmers obtained their information mainly through friend and nighbours (47.2) and extension agents (40%). This implies that farmer-to- farmer extension network is a major information source; also the result shows that the extension service is fulfilling her mandate of disseminating improved technologies .This findings is in agreement with that of Agbamu (1998) who pointed out that farmers obtained information through several sources but most importantly through extension agents and their fellow farmers

Table 2: Distribution of respondents based on access to improved potato packages and sources of information

Variables	Frequency	Percentage
Access to improved sweet potato		
Access	93	62.0
No access	57	38.8
Sources of improved sweet potato		
Research institute	35	23.3
Other farmers	42	28.0
ADPs	56	37.3

State Ministry of Agric.	17	11.3

Source; Field survey,2012

Table 2 shows that Majority (62%) of the respondents claimed that they had access to improved sweet potato varieties .This implies that farmers readily had access to improved seed, access to improved seeds is also a major factor in the adoption process. Also majority of the respondents sourced their improved seeds from government owned institutions and organizations, such as research institute (23.3%), ADPs (37.3%) and state ministry of agriculture (11.3%). This implies that majority of the sweet potatoes farmers who adopted improved potato varieties sourced their planting material from government sources. This findings is in agreement and confirm the claims of IPC (2012) that they directly worked with government and Non-governmental agencies in distributing improved potatoes to the farmers.

Table 3: Distribution of respondents according to access to extension services and frequency of contact

Variables	Frequency	Percentage (%)
Access to Extension agents		
Yes	139	92.7
No	11	7.3
Frequency of contact		
Weekly	31	20.7
Monthly	155	76.7
Quarterly	1	0.7
Yearly	3	2.0

Source: Field survey, 2012

The entries in table 3 indicated that overwhelming proportion of the respondents (92.7%) readily had contacts with the extension agent, and majority (76.7%) usually had frequent contact with extension agents on monthly bases. The level of contact with extension agent is also significantly and positively associated with adoption of improved technologies. This result is in line with those of Van dan Ban and Hawkins (2006) who affirmed that frequent contact with extension agents had significant effect on adoption

Table 4: Distribution of respondents based on stages and levels of adoption of various improved potato production technologies

Improved technologies	Not aware=1	Aware stage=2	Interest stage=3	Evaluation stage=4	Tried stage=5	Adoption stage=6	Sum	Mean	Remark
Planting of Improved varieties	19(12.7)	96(64.0)	1(0.7)	_	13(8.7)	21(14.0)	405	2.7	**Low**
Timeliness in planting	15(10.0)	79(52.7)	2(1.3)	_	29(19.3)	25(16.7)	474	3.2	**Moderate**
Recommended spacing	35(23.3)	59(39.3)	3(2.0)	_	23(15.3)	30(20.0)	457	3.0	**Moderate**
Planting pattern	40(26.7)	50(33.3)	6(4.0)	1(0.7)	24(16.0)	29(19.3)	456	3.0	**Moderate**
Fertilizer application	21(14.0)	59(39.3)	2(1.3)	_	19(12.7)	49(32.7)	534	3.6	**High**
Sweet potato intercrops	49(32.7)	41(27.3)	2(1.3)	_	28(18.7)	30(20.0)	457	3.0	**Moderate**
Weeding regime	22(14.7)	48(32.0)	2(1.3)	1(0.7)	34(22.7)	43(28.7)	552	3.7	**High**
Harvesting technique	18(12.0)	51(34.0)	1(0.7)	_	24(16.0)	56(37.3)	579	3.9	**High**

Source: Field survey, (2013)

- ★ **High - Mean scores equals to or greater than 3.5**
- ★ **Moderate Adoption- Mean scores between 3.0-3.4**
- ★ **Low Adoption- Mean scores less than 3.0**

Table 4 shows the level at which the respondents adopted the various improved potato production technologies; the following improved technologies were highly adopted because their

means were either equal to or above 3.5; Fertilizer application (3.6), weeding regime (3.7) and timely harvesting (3.9). Also the following improved technologies were moderately adopters because their means scores falls between 3.0-3.4, Time of planting (3.2), recommended spacing (3.0), Planting pattern (3.0) and sweet potato intercrops (3.0). Meanwhile planting of improved varieties was rated low (2.7). This implies that majority of the sweet potatoes farmers were still using their local varieties, this can be attributed to conservativeness and fear of unknown.

Table 5: Distribution of respondents based on their perception of the constraints

Constraints	Very important=4	Important =3	Slightly important=2	Not important=1	Sum	Mean	Remark
Small farm size	99(66.0)	45(30.0)	5(3.3)	1(0.7)	587	3.9	Important
Cost of technology	42(28.0)	75(50.0)	25(16.7)	8(5.3)	451	3.0	Important
Inadequate extension contact	41(27.3)	65(43.3)	33(22.0)	11(7.3)	436	2.9	Important
Poor communication system	28(18.7)	77(51.3)	39(26.0)	6(4.0)	427	2.8	Important
Accessibility to improved varieties	31(20.7)	86(57.3)	23(15.3)	10(6.7)	438	2.9	Important
Technology too complex to understand	30(20.0)	76(50.7)	30(20.0)	14(9.3)	422	2.8	Important
Inadequacy of improved technologies	19(12.7)	86(57.3)	34(22.7)	11(7.3)	413	2.8	Important
Religious belief	13(8.7)	31(20.7)	21(14.0)	85(56.7)	272	1.8	Not important
Labour	11(7.3)	94(62.7)	28(18.7)	17(11.4)	399	2.6	Important
Low price of potatoes	22(14.7)	98(65.3)	15(10.0)	15(10.0)	427	2.8	Important
Inactive farmers association	33(22.0)	93(62.0)	19(12.7)	5(3.3)	454	3.0	Important
Inadequate credit	30(20.0)	112(74.7)	3(2.0)	5(3.3)	468	3.1	Important

Source: Field survey, (2013).

Table 4.24 shows the perception of the respondents about the constraints they faced, the following constraints were perceived as important because their mean scores were either equal to or greater than 2.5 which is the cut up mean. Small farm size (3.9), Cost of technology (3.0), Inadequate extension contact (2.9), Poor communication system (2.8), Accessibility to improved varieties (2.9), Inadequate improved technologies (2.8), Technology too complex to understand (2.8), Labour (2.6), Low price of potatoes (2.8), Inadequate credit (3.1) and inactive farmers associations (3.0). While Religious belief (1.8) was perceived as not important. Farmers perception of the constraints faced in adoption process signicantly affect the rate of adoption. This is in line with Van dan Ban and Hawkins (2002) finding that perception significantly affects adoption either positively or negatively

Table 6 Factors affecting the rate of adoption of improved potato technologies

Variables	Coefficient	Z-value
Constant	-0.092	-0.09
Age (X_1)	-0.096	-3.03 ***
Farm size (X_2)	-0.954	2.39 **
Educational level (X_3)	-0.083	3.12 ***
Farming experience (X_4)	-0.045	1.69 *
Household size (X_5)	-0.161	2.05 **
Access to extension agents (X_6)	-0.552	0.77 NS

Source: Field survey, (2013)

Pseudo R^2=0.131

Note: ***= Significant at 1% **= Significant at 5% *= Significant at 10%

NS= Not significant

The result in table 6.Shows that the model had a Pearson Goodness of Fit. Test of Chi-square value of 27.23 which is significant at 1% level. The coefficient of Age (X_1) is significant at 1% level but negatively correlated with adoption of improved sweet potato production technologies. This implies that as the farmers get older the propensity to accept and adopt new technologies decreases. Farm size (X_2) was significant at 5% level, Educational level (X_3) was significant at 1% level, Farming experience (X_4) of the respondent was significant at 10% level and Household size (X_5) was significant at 5% level. These variables are significant and are positively correlated with adoption of improved sweet potato production technologies. This implies that these significant variables were major determinants of adoption of improved sweet potato production technologies. This agrees with the finding of Agbamu (1991) who pointed out that socio-economic and institutional factors significantly affect the level of adoption of improved packages of practices.

Table 7: Average Marginal Effect of the significant Explanatory Variables

Variables	Standard Error	Z-value
Age	0.01	-3.42
Farm size	0.08	2.56
Education	0.00	3.56
Farming experience	0.00	2.06
Household size	0.02	2.16

Source: Field Survey, (2013)

The result on table 7 shows the marginal effects of significant factors, a unit increase in age will lead to reduction in adoption rate of the farmer's by 3.4%, which implies that as the farmers grows older, the propensity to accept and adopt new technologies reduces. Other variables like; farm size (2.56), education (3.56), farming experience (2.06) and house hold size (216) were significantly and positively related with adoption, This implies that a unit increase in all of these significant variables will automatically led to an increase in the rate adoption with the corresponding percentage values

Table 8: Test of hypothesis

HO -There is no significant difference in sweet potato yield before and after adoption of improved sweet potato production technologies

Mean scores	Variance	Z –value	Significance
Before adoption74.06	17411.13	-1.25	0.003***
After adoption 95.17	25173.63		

The result in table 8 showed a significant mean deference in yield before (74.06) and after (95.17) adoption of improved potato production technologies, significant at 1%. The null hypothesis is here by rejected and the alternative hypothesis which state's that there is significant difference in potato yield before and after adoption of improved sweet potato production technologies is accepted. Implying that adoption of improved potato production technologies had the tendency to boast potato production in the study area This result is in line with those of Alfred (2000) and IPC (2012) who pointed out that adoption of improved techniques usually resulted into increase in output, income and consequently improvement in the standard of living.

CONCLUSION AND RECOMMENDATIONS

The main difference in income of the respondents before and after adoption of improved potato technologies was an indication that adoption of improved technologies is profitable.

The conclusion is that success in achieving a viable potato production and contributing to food security depends on the level of awareness, availability of technologies, level of adoption and potato farmers' perception of the technologies

Based on the foregoing, it is recommended that constraints limiting the adoption of improved potato technologies should be addressed through holistic approach. that is, by every segment of the agricultural sector playing their roles as expected.

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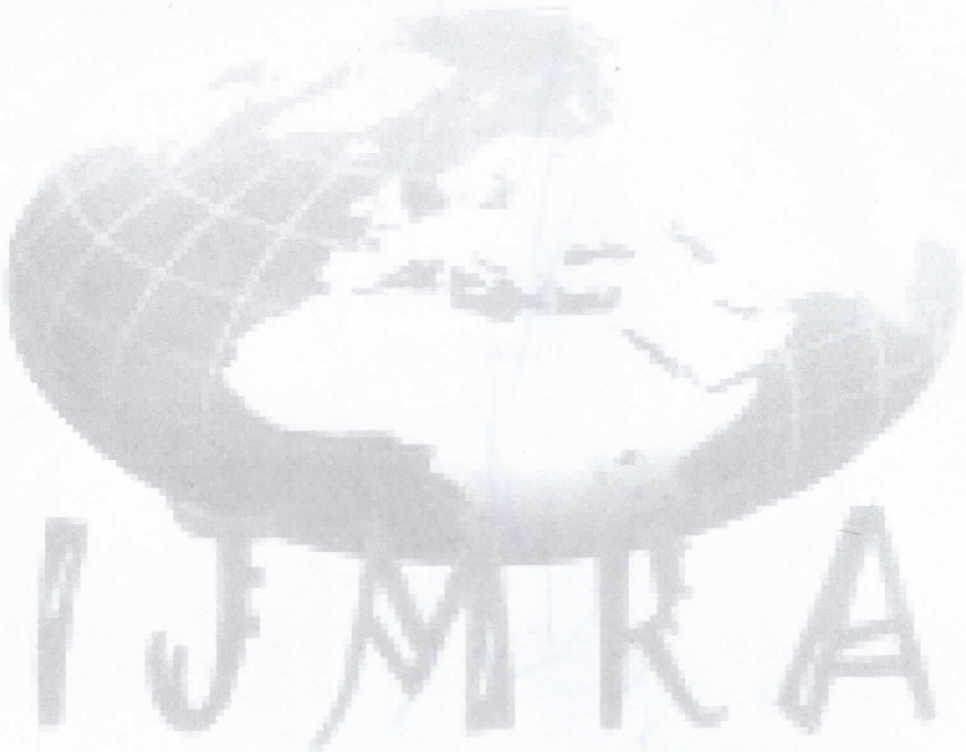

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EFFECTS OF SOCIO-ECONOMIC FACTORS ON THE ADOPTION OF IMPROVED PRODUCTION TECHNOLOGIES BY FISH FARMERS IN KOGI STATE, NIGERIA

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I.O. Overo**

Abstract

This study investigated the effects of socio- economic factors on the adoption of improved technologies by fish farmers in Kogi state, Nigeria. The specific objectives of the study were to examine the socio-economic characteristics of the fish farmers, ascertain the level of awareness of improved fish production technologies, identify the improved fish production technologies adopted and determine the factors affecting the adoption of improved technologies by the fish farmers in the study area. Five Local Government Areas were purposively selected for the study because of the concentration of fish farmers in the areas. They are Lokoja, Idah, Ajaokuta, Kabba/Bunu and Ankarfe. A total of 80 fish farmers (using multi stage sampling techniques) were selected and information elicited from them using interview schedule. Data analysis involved descriptive and inferential statistics. Result shows that the mean age of the fish farmers was 47 years. Stocking (93.8 %), fish feeding technique (91.2 %), harvesting (81.3 %) and pond draining method (%) were the most adopted technologies. Binomial logit regression indicated that at 0.05 level of significance, there was a positive and significant relationship between education and extension visits. Stakeholders should encourage education and extension visits in orderto enhance the food status of the study area and consequently Nigeria.

Keywords: Fish farmers, Technology, Adoption

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INTRODUCTION

Out of the three fundamental needs of human beings (i.e. food, clothing and shelter), food is probably the most important. Food contains nutrients that give energy, growth and maintenance of health. Achieving and maintaining food security is a fundamental problem facing the world today. Despite substantial increase in food production in many countries, over 500 million people still suffer from malnutrition (Tacon, 2001).

Aquaculture which has been defined as the husbandry of aquatic organisms such as fish, shellfish and even plants is an integral sub-sector of agriculture and it is still one of the primary occupation of most people in developing nations of the world. It is an essential part of the world's food producing sector, providing about 50 % of the world's food fish supply (FAO 2011).

In the year 2010, capture fisheries and aquaculture provided the world population with about 148 million metric tonnes of fish, of which about 128 million tonnes was utilized as food for people (FAO, 2010). With sustained growth in fish production and improved distribution channels, world fish food supply has grown dramatically in the last five decades, with an average growth rate of 3.2 % per year in the period 1961 – 2009, outpacing the increase of 1.7 % per year in the world population (FAO, 2010).Aquaculture development has not realized its potential in many developing countries as the need for integrating aquaculture development into overall comprehensive rural development programs has not been fully appreciated. While an annual growth of 14 % in aquaculture appears impressive, most of the growth has been recorded in China with only about 4.4 % occurring in other countries. The least developed countries (LDCs), mostly in Sub- Saharan Africa and in Asia; remain minor in terms of their share of world aquaculture production (4.1 % by quantity and 3.6 % by value). However, some developing countries in Asia and Sub- Saharan Africa including Nigeria are making rapid progress to become significant or major aquaculture producers in their regions. Therefore, fish and fishery products represent a very valuable source of protein and essential micronutrients for balanced nutrition and good health. In 2009, fish accounted for 16.6 % of the world population's intake of animal protein and 6.5 % of all protein consumed (FAO, 2010)

In Nigeria, production of fish from aquaculture experiences an annual increase of 10 % which accounts for about 20 % of the domestic need. This rate is translated to about 80, 000 metric

tonnes of fish per annum which is far less than national demand of 1.5 million metric tonnes (www.africanagriculture.com, 2008). The only way the deficit of 1.1 million metric tonnes can be met is through importation which will cost the country about $241 million per annum if local production cannot meet the deficit (www.africanagriculture.com, 2008).

According to the World Fish Centre (2007), one of the promising solutions to the shortage of animal protein intake in developing countries is the proper development of aquaculture.

The total environment can be divided into two elements namely: technology and human. Technology determines the type and physical potential for fish farming, including the physical and biological factors that can be modified through technology development. The human element is characterized by exogenous (community structures, external institutions etc.) and endogenous factors, which can be controlled by the farm household. At the centre of this interaction is the fish farmer. The fish farmer ultimately decides on whether or not to adopt technologies and how to assign resources to support them (Ingold, 2002).

Problem Statement

Fish constitutes a major source of protein in human diet and it has no religious rejections or bias when compared with other animal sources of protein like pigs which is condemned by the Muslims and cattle by the Hindus.

Fish is a relatively cheaper source of protein. It has an important role in world protein supplies particularly in developing countries. Besides protein, fish provides energy, fatty acids, vitamins and minerals (Ladipo, 1994). It is also a well-known fact that animal protein is seriously inadequate in the daily diet of many people in the tropics including Nigeria.

Fish oil is also rich in vitamins A and D, which are needed for the proper functioning of the eyes and healthy bone development. Protein deficiency is responsible for a number of illness and death. It reduces immunity to diseases and can lead to poor growth (Nwuba and Onuoha, 2006).

The continued increase in desert encroachment has resulted in greater dependency on fish as the main source of animal protein. Fish is particularly adapted to the water environment but show great variation in size as well as in shape. The main sources of fish supply in Nigeria are domestic fish production and fish importation.

Nigeria is blessed with about 1.5 million hectares of bond water mass, capable of producing over 1.5 million metric tonnes of fish annually (Ita, 1996). However, the current overall fish production is estimated at 0.6 million metric tonnes of which aquaculture produced some 30, 000 metric tonnes of various freshwater and brackish water fish species in 2000 (Fagbenro, 2005). Due to yearly decline in fish harvest from oceans, rivers and lakes and continued stable demand for fish product, there is rising interest in aquaculture with domestication of more fish species.

The need for the availability of enough food in order to sustain life and good health of the entire world's population at all times across all countries and regions, across all income groups and all members of households requires the supply of an adequate amount of food so as to meet the nutritional requirements/need of all people at all times cannot be overemphasized (Williams, 1996).

Objectives of the study

The broad objective of the study was to evaluate the effects of socio – economic factors on the adoption of improved production technologies by fish farmers in Kogi state, Nigeria.

The specific objectives were to:

I. describe the socio- economic characteristics of the fish farmers in the study area.
II. ascertain the level of awareness of improved fish production technologies by the fish farmers in the study area.
III. identify the improved fish production technologies adopted by the fish farmers in the study area and ;
IV. determine the factors affecting the adoption of improved technologies by the fish farmers in the study area.

Methodology

The study was conducted in Kogistate which was purposely selected due to the prevalence of fishery activities in the states. Kogi state was formed in 1991 from parts of Kwara and Benue states. The state lies on latitude 7.9^0 North and longitude 6.45^0 East. It is bordered to the east by Benue state, Northeast by Nassarawa state, Enugu, Anambra and Delta states borders the state to the south while Ondo, Ekiti and Kwara states borders the state to the weat. Niger state and the Federal Capital Territory, Abuja borders the state to the North.

Kogi state has a total land area of 28, 313.53 square kilometres and a projected population of 3,278,487 people according to the census conducted in 2006 (Encyclopaedia Britannica, 2013).

Population of the Study

The population for the study consist of all registered fish farmers in the study area. The total number of fish farmers registered and scattered throughout Kogi State at the time of the study was 250 (Kogi State Agricultural Development Project).

Sampling Technique and Sample size

5 Local Government Areas (LGAs) each having the highest number of registered fish farmers were selected. The selected LGAs in Kogi state were Lokoja, Idah, Ajaokuta, Kabba/Bunu and Kotonkarfe. 60 % of the registered fish farmers in each of the selected LGAs were sampled. A total of 80 respondents were used. The detail of the sample size is as shown in table 3.1

Method of Data Collection

Data were elicited from the fish farmers by using structured interview schedule designed in line with the objectives of the study, administered by the researcher with the assistance of trained enumerators.

Table 3.1: Selection of the Respondents from Five Local Government Area in Kogi State.

Local Government Area	Number of Fish Farmers	Number of Respondents Sampled
Lokoja	45	27
Idah	32	19
Ajaokuta	25	15
Kabba/Bunu	20	12
Kotonkarfe	12	7
Total	134	80

Source: Kogi State Agricultural Development Project, 2012.

Analytical Techniques

Objectives I, II and III: This was analysed using descriptive statistics such as frequency distribution, tables, percentage, mean and standard deviation to group and summarize the data obtained from the field.

Objective IV: To achieve the research objective, a multinomial logit model was constructed and estimated as used by Bandara and Thiruchelvam (2008). The fish farmers were categorized based on the number of technologies adopted.

The explicit form of the function is specified as follows:

$$Y_i = X_O + X_1AGE + X_2EDU + X_3EXP + X_4POS + X_5SOP + X_6EXC + X_7YLD + X_8HHS$$

Table 3.4: Definition of the Independent Variables used in Adoption Models of the Fish Farmers.

Variables	Definitions
AGE	Chronological age in numbers of completed years by the respondent at the time of interviews.
EDU	Number of years spent in school.
EXP	Number of years to which a respondent has been practicing fish farming.
POS	Extent of water area (in m^2) used for fish farming.
SOP	Extent to which the respondent participated in the activities of formal social organization.
EXC	Frequency of contact of a respondent with any extension personnel.
YLD	Total quality of yield/output in kg/m^2.
HHS	Household or family size.

RESULTS AND DISCUSSION

The results in table 4.1 reveals that majority of the fish farmers (85.0 %) were within the age bracket of 20 – 50 years.

This indicates that young and middle aged people are involved in fish farming. This is because fish farming requires adequate attention and a lot of sense of responsibility. The result agrees with the findings of Ofuoku*et al.,* (2008) who reported that people above the age of 50 years were few in fish farming because they lack adequate stamina required in the management of the fish farms.

The male dominance of this source of livelihood might be due to the laborious nature of fish farming operations right from pond construction to management. The finding obtained is in agreement with that of Basorun and Olakunleyin (2007) that stated that fish farming is male dominated.

87.2 % of the respondents had secondary education and above which implies that majority of the respondents are educated. Farmers' education level has been found to positively influence the adoption of improved production technologies (Obukosia, *et al.* 2004). The fish farmers' level of education encouraged the adoption of improved production technologies.

60 0 % of the respondents had a household size of between 6 – 10 persons implying that the respondents had moderate household size.

Household size is an important factor in agriculture because to a large extent, it determines the extent of labour supply available. The results obtained is in line with that of Olanipekun and Kuponiyi (2009) who said that large family size is an incentive for engaging in livelihood diversification in order to meet family obligations.

Table 4.1: Socio- Economic Characteristics of Sampled Fish Farmers

	Kogi State (n=80)	
Variables	Frequency	Percentage

Age (years)		
Below 21	1	1.3
21 – 30	6	7.5
31 – 40	14	17.5
41 – 50	48	60.0
Above 50	11	13.7
Total	80	100.0
Sex		
Male	72	90.0
Female	8	10.0
Total	80	100.0
Marital Status		
Single	6	7.5
Married	74	92.5
Divorced/Separated	-	-
Total	80	100
Level of Education		
No form of Education	-	-
Quranic/Adult Education	-	-
Primary	9	11.3
Secondary	61	76.2
Tertiary	10	12.5
Total	80	100.0
Household Size	25	31.3
< 6	48	60.0

6 – 10	7	8.7
11 – 15	-	-
16 and above	80	100.0
Total		
Fish Farming(years)		
< 6	36	45.0
6 – 10	38	47.5
11 – 15	6	7.5
16 and above	-	-
Total	80	100.0

Source: Field survey 2012

The reason of high adoption rate for stocking, fish feeding and pond drainage is because it will ultimately determine the yield (output). Stocking implies the number of fish put in water, feeding is the quantity and quality of nutrients needed by fish as well as the timing of giving feed to the fish. Maintenance is also paramount because it will prevent outbreak of diseases as well as reduce retarded growth in fish.

The technologies that had low adoption which include pond fertilization, earthen pond and plastic/fibre pond may be due to economic reasons as plastic/fibre ponds are expensive and may not be affordable by the fish farmers.

Table 4.11: Distribution of Fish Farmers' Awareness, Trial and Adoption of Improved Technologies in Kogi State.

Variables	Aware (100 %)	Trial (100 %)	Adoption (100 %)

Stocking method	80 (100.0)	80 (100.0)	75 (93.8)
Fish feeding technique	80 (100.0)	80 (100.0)	73 (91.2)
Pond fertilization method	80 (100.0)	80 (37.5)	16 (20.0)
Maintenance	76 (95.0)	69 (86.2)	45 (56.2)
Pond draining method	80 (100.0)	74 (82.5)	55 (68.8)
Harvesting	80 (100.0)	80 (100.0)	65 (81.3)
Concrete Pond	80 (100.0)	75 (93.8)	49 (61.3)
Earthen Pond	80 (100.0)	40 (50.0)	20 (25.0)
Plastic/Fibre Pond	80 (100.0)	20 (25.0)	11 (13.8)

Source: Field Survey, 2012

Educational Status of the fish farmers: Educational status has a positive and significant relationship with the adoption of improved technologies at 1 % probability level. This implies that the more educated the fish farmers, the more the chances of their ability to access information and hence they have capacity to analyse such information and make valid decisions that will enhance their fish farming activities when compared to their illiterate colleagues. This agrees with the findings of Tologbonse (2004) who stated that education affects the speed with which new technologies are diffused and accepted by the farmers.

Extension Visit: Extension visit had a positive influence on the adoption of improved technologies at 1 % probability level. Extension contact offer support services to the farmers as well as teaching them on how to improve upon their present practice and this will enhance the process of adoption. This implies that the more contact the fish farmers have with extension agents, the more likely they will adopt improved technologies. This is in agreement with the findings of Tadesse (2008).

Output: The output (yield) of the fish farmers positively and significantly influenced the probability of adoption of improved technologies at 5 % significant level. The output of farmers

also determines the income of the farmers. This implies that as the output increases, the financial status of the fish farmers is enhanced and they are likely to adopt improved technologies.

Table 4.29: Binomial Logit Regression showing the Factors Affecting the Adoption of Improved Technologies by Fish Farmers in Kogi State.

Variables	Marginal Effect	Coefficient and Z-Values
Constant		-3.0278 (-1.61)
Age		-0.0246 (1.06)
Education(years)		0.1138 (2.24) ***
Experience		0.0367 (0.85)
Pond Size		0.0032 (0.75)
Cooperative Membership		0.1675 (0.29)
Extension Visit		0.6544 (4.37) ***
Training		-0.1980 (--0.29)
Output (Yield)		0.0007 (2.19)**
Household Size		-0.0102 (-0.11)
Average Marginal Effect: Extension Visit	0.0951	(7.71)
Education	0.0165	(2.41)
Output	0.0001	(2.39)

Number of Observation = 100 Numbers in Parenthesis are Z values

Log likelihood = - 44.6846

LR Chi-Square = 46.00

Pro>Chi-square = 0.0000

Pseudo R^2 = 0.3341

***= Significant at 1% level of probability

Source: Field Data Analysis 2012

Conclusion

From the study, majority of the fish farmers were aware of improved fish production technologies but stocking method, fish feeding technique, harvesting and pond draining method. Education, extension visit, and age were significant factors affecting adoption of improved technologies by fish farmers. In order to increase the level of fish production, extension visits should be improved upon both in the quality of information delivery and frequency of visit. Formal and informal education should be encouraged among the fish farmers in the study area.

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